

# Semester 6

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B. Tech 3<sup>rd</sup> year(6<sup>th</sup> Semester) Mechatronics

Course No.	Course Title	Teaching Schedule				Allotment Marks				Duration of Exam
		L	T	P	Total	Sessional	Theory	Practical	Total	
MT-302	Applications of Control	3	1	-	4	50	100	-	150	3
MT-304	Digital & Embedded Softw. (RT sys) 2	3	1	-	4	50	100	-	150	3
MT-306	Engineering Mathematics Apps 2	3	1	-	4	50	100	-	150	3
MT-308	Pneumatic And Hydraulic Instrumentation	3	1	-	4	50	100	-	150	3
MT-310	Production Technology-II	3	1	-	4	50	100	-	150	3
HUT-302E	Fundamentals of management	3	1	-	4	50	100	-	150	3
MT-312	Production Technology-II lab	-	-	3	3	50	-	50	100	3
MT-314	Digital & Embedded Softw. (RT sys) 2 Lab	-	-	2	2	25	-	25	50	3
MT-316	Applications of Control Lab	-	-	2	2	50	-	50	100	3
	Total	18	6	7	31	425	600	125	1150	

Students are allowed to use single memory, non-programmable scientific calculator during examination.

## MT - 302

### Applications of Control

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>-</b>

**Sessional: 50 Marks**  
**Theory: 100 Marks**  
**Total: 150 Marks**  
**Exam Duration: 3 Hours**

#### Unit 1

##### INTRODUCTION

Concepts of Control Systems- classifications of control system and their differences. Different examples of control systems. Modeling of typical elements of a servo mechanism (motor, gearbox, amplifier and sensors). Block diagram reduction and Signal flow graph algebra. .

#### Unit II

##### TIME RESPONSE ANALYSIS

Standard test signals - Time response of first order and second order systems. Steady state response: Steady state errors and error constants. Effect of addition of poles and zeros to transfer functions. Responses with P, PI and PID Controllers

#### Unit III

##### STABILITY ANALYSIS

Concepts of Stability -S-plane and frequency response analysis-gain and phase margins. Routh Stability Criterion-Necessary and sufficient condition of stability-special cases. Root Locus Technique: The root locus concept - construction of root loci-effects. Frequency response analysis - Bode plots – GM and PM -Stability Analysis from Bode Plots. Nyquist Plots: Nyquist Stability Criterion, Assessment of relative stability. Compensation techniques –classifications-Lag, Lead and Lag lead compensator.

#### Unit IV

##### STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS

Concepts of state, state variables and state model, derivation of state models from block diagrams- State space representations– Solutions of state equations. Concepts of Controllability and Observability.

### TEXT BOOKS:

1. Linear control system with MATLAB Applications- B.S Manke, Khanna Publishers
2. Automatic Control Systems 8th edition– by B. C. Kuo 2003– John Wiley and son’s.,
3. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 2nd edition.

### REFERENCE BOOKS:

1. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.
2. Control Systems Engg. by NISE 3rd Edition – John Wiley

### Note:-

**Examination :-** The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

**Assignment :-** Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO’s as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

### Learning outcomes(LO’s)

1. Derive theoretical models for the study of engineering control systems.	Knowledge & Understanding
2. Improve on an undamped control system in order for it to exhibit a stable response.	Enquiry and Problem Solving
3. Investigate and report upon the use of control in improving a system's response.	Communication

## MT - 304

### Digital and Embedded Softw. (RT sys) 2

L    T    P  
3    1    -

Sessional: 50 Marks

Theory: 100 Marks

Total: 150 Marks

Exam Duration: 3 Hours

#### UNIT-1

**Introduction to Microcontroller:** -Evaluation of Microcontrollers. Classification of Microcontroller – On the basis of architecture and instruction set. Embedded processor. Comparison between Microprocessor and Microcontrollers. A brief history of 8051. Overview of 8051 microcontroller family. Block Diagram and Architecture of 8051. Pin Description of 8051 microcontroller.

#### UNIT-2

**Assembly and C programming of Microcontroller** :- 8051 Instruction Format, Addressing modes, Data transfer instructions. Logical operations, Arithmetic operations, looping, jump and call instructions, Time Delay programming. SFR (Special Function Registers). Development of different programs. Data types and Time Delays in 8051 C. Logic and Arithmetic operation in C.

#### UNIT-3

**8051 Internal Architecture:** - I/O port programming. Serial communication using 8051. Counter and Timers programming. Different modes of timer. Serial data input / output, Setting Baud Rate. Interrupt Programming – timer interrupts, external hardware interrupts, serial communication interrupt, priority interrupt. External memory interfacing.

#### UNIT-4

**Interfacing of microcontroller:** -Microcontroller based seven segment numeric displays. Microcontroller interfacing with keypad, Microcontroller based D/A & A/D converters and Microcontroller based LCD display. Motor interfacing with microcontroller 8051.

#### TEXT BOOKS

1. The 8051 Microcontroller And Embedded Systems Using Assembly And C: Muhammad Ali Mazidi.
2. The 8051 Microcontroller: Kenneth J. Ayala

#### REFERENCE BOOKS

1. The 8051 Microcontroller: Mackenzie
2. 8051 Microcontroller: Internals, Instructions, Programming & Interfacing: Ghoshal Subrata

#### Note:-

**Examination :-**The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

**Assignment :-** Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO's as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

**Learning outcomes(LO's)**

1. Extend C programming to interface to microcontroller hardware(electro/mechanical).	Analysis, Application and Problem Solving
2. Understand the connection between C and the embedded engineering product.	Analysis, Application and Problem Solving
3. Apply the development cycle of embedded system design to an engineering application.	Analysis, Application and Problem Solving

## Engineering Mathematics Apps 2

MT-306

L    T    P  
3    1    -

Sessional: 50 Marks  
Theory: 100 Marks  
Total: 150 Marks  
Exam Duration: 3 Hours

### UNIT – I

Trigonometric Functions: Positive and negative angles. Measuring angles in radians and in degrees and conversion from one measure to another. Definition of trigonometric functions with the help of unit circle. Truth of the identity basic trigonometric identities, for all angles. Signs of trigonometric functions.

Expressing sum and difference of trigonometric angles and their simple applications.

### UNIT-II

Trigonometric Identities & Equations: Identities related to multiple trigonometric angles. General solution of trigonometric equations.

Inverse Trigonometric Functions: Introduction, Basic Concepts, Properties of Inverse Trigonometric Functions.

### UNIT-III

Numerical solution of Differential Equation: Introduction, Taylor's series method, Euler's and Modified Euler's method, RungeKutta Method, Milne's Predictor and Corrector Method, Picard's Method of Successive Approximation, .ABM Method

### UNIT-IV

Three Dimensional Geometry: Introduction, Direction Cosines and Direction Ratios of a Line, Equation of a line in space, Angle between two lines, shortest distance between two lines.

Plane, Co-planarity of Two lines, Angle between two planes, Distance of a Point from a Plane, Angle between a line and a plane.

#### Text Book

1. Higher Engg. Mathematics : B.S. Grewal
2. Advanced Engg. Mathematics : E. Kreyzig

#### Reference Book

1. Engg. Mathematics Vol. II: S.S. Sastry; Prentice Hall of India.

**Note:-**

**Examination :-** The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

**Assignment :-** Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO's as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

**Learning outcomes(LO's)**

1) Understand about Trigonometry and inverse trigonometric functions
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2) Understand about numerical methods and Introduction to 3D
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## Pneumatic And Hydraulic Instrumentation

MT-308

L T P  
3 1 -

Sessional: 50 Marks  
Theory: 100 Marks  
Total: 150 Marks  
Exam Duration: 3 Hours

### UNIT – I

Introduction: Basic requirement for Pneumatic System, Servicing compressed air: Air compressors, air treatment stages, pressure regulation(FRL unit) Introduction to hydraulic system comparison of pneumatic & hydraulic system.

### UNIT – II

Pneumatic & hydraulic Actuators, cylinders Spring, spring less, spring with positioner piston & motor actuators, electro pneumatic actuators, cylinder lubrication, cylinder with sensors, hydraulic actuators, control valves types of control valves, basic pneumatic circuits.

### UNIT – III

Timing & sequence diagram : Cylinder sequencing hydraulic & pneumatic Accessories pneumatic telemetry systems: Pneumatic temperature & pressure transmitters their working & applications, electrical control in pneumatic circuit. Introduction to PLC, architecture of PLC , Programming of PLC.

### UNIT – IV

Pneumatic & Hydraulic Controllers(P,PI,PID),P&ID diagrams, converters :I/P,P/I, Pneumatic Relay, Pneumatic Sensors Flapper nozzle assembly. Maintenance & troubleshooting of pneumatic & hydraulic systems. Introduction to Mechatronics & its approach.

### TEXT BOOKS:

1. Process Control Instrumentation Technology, C. D. Johnson ,PHI, 2002
2. Computer based Industrial Control, Krishankant PHI,2004
3. Pneumatic & Hydraulic, Andrew Parr PHI, 1999.

### REFERENCE BOOKS:

1. Process Industrial Instruments & Control Handbook D.Considine , McGraw Hill ,1993.
2. Instrument Engineers Handbook ,B.G Iptak ,BH Publication ,1999.

### Note:-

**Examination :-** The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

**Assignment :-** Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO's as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

### Learning outcomes(LO's)

1) Understand about basic elements of Pneumatic System and hydraulic Actuators
2) Understand about Timing & sequence diagram.
3) Learn about Pneumatic & Hydraulic Controllers(P,PI,PID).

**Production Technology-II**  
**MT-310**

**L**    **T**    **P**  
**3**    **1**    **-**

**Sessional: 50 Marks**  
**Theory: 100 Marks**  
**Total: 150 Marks**  
**Exam Duration: 3 Hours**

**UNIT I**

**Kinematics of Machine Tools.**

Drives in machine tools for rotation movement, stepped and step less drives, mechanical and hydraulic drives, Individual and group drives, selection of extreme values of spindle speed on a lathe, principle of stepped regulation, Layout of spindle speeds. A.P., G.P. and Logarithmic progressions, Kinematics advantage of G. P. for gear box design, selection of common ratio, Number of steps in a given speed range, design of all geared head stock.

**UNIT II**

**Gear manufacturing and layout for Automatics**

Classification of gear production methods, gear generation, gear hobbling gear shaping, gear finishing methods; shaving, burnishing grinding, Lapping gear shaping, gear finishing methods; shaving, burnishing grinding, honing.

Automatic lathes, classification of automatic machines, setting up of automatics, tooling layout and operation sheet, cam design, tool layout of automatic screw machine, programmed automatic lathes, bar stock feeding.

**UNIT III**

**Unconventional Machining Processes & Press Working Tools**

Need for unconventional processes, Ultrasonic machining, electrochemical machining, electrochemical grinding, Laser beam machining their process parameters, principle of metal removal, applications advantages and limitations.

Introduction, classifications of presses and dies, hear, action in die cutting operations, center of pressure, mathematical calculation of center of pressure, clearances, cutting forces, punch dimensioning.

**UNIT-IV**

**Machine Tools Vibration and Dynamometry**

Introduction, effects of vibration no-machine tools, cutting conditions, work piece and tools life, source of vibration, machine tool chatter, Need for measuring forces, basic requirements of measuring techniques, design requirements of dynamometers, 3-divisional turning dynamometer and its calibration, drill dynamometers.

**Suggested reading:**

1. Manufacturing science: Ghosh and Malik, E.W. Press

2. Principles of metal cutting: Sen and Bhattacharya, New Central Book.
3. Metal cutting principles: Shaw, MIT Press Cambridge
4. Manufacturing analysis: Cook, Adisson-Wesley
5. Modern machining processes: Pandey and Shan, Tata McGraw Hill Publications

**Note:-**

**Examination :-** The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

**Assignment :-** Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO's as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

**Learning outcomes(LO's)**

1) Understand Kinematics of Machine Tools and tool layout of automatics
2) Understand Unconventional Machining Processes & Press Working Tools.
3) Understand Machine Tools Vibration and Dynamometry.

## FUNDAMENTALS OF MANAGEMENT

### HUT-302E

**L**    **T**    **P**  
**3**    **1**    **-**

**Sessional: 50 Marks**  
**Theory: 100 Marks**  
**Total: 150 Marks**  
**Exam Duration: 3 Hours**

#### **UNIT-I      Financial Management**

Introduction of Financial Management Objectives of Financial Decisions, Status and duties of Financial Executives Financial Planning – Tools of financial planning Management of working capital Factors affecting requirements of working capital. Sources of finance Use of financial ratios for analyzing performance of company

#### **UNIT-II      Personnel Management**

Personnel Management – Meaning, Nature and Importance; Functions of Personnel Management – (a) Managerial Functions and (b) Operative functions Job Analysis: Meaning and Importance; Process of Job Analysis; Job Description and Job specification. Job rotation and Job enlargement, Job enrichment, Human Resource Development-Meaning and concept

#### **UNIT-III    Production Management**

Production Management: Definition and Objectives  
Plant location: Ideal plant location. Factors affecting plant location.  
Plant Layout: Ideal plant layout, factors affecting plant layout  
Work Measurement: Meaning, Objectives and Essentials of work measurement. Production Control: Meaning and importance of production control and steps involved in production control Inventory management, ABC analysis, Economic order quantity, Just in Time

#### **UNIT-IV    Marketing Management**

Nature, scope and importance of marketing management. Modern Marketing concepts. Role of marketing in economic development. Marketing Mix. Marketing Information System Meaning, nature and scope of International Marketing Supply chain management

#### **Note:-**

**Examination:-** The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

**Text Books:**

Financial Management, IM Pandey, Vikas Publishing House Pvt Ltd

Marketing Management, Philip Kotler, Kevin Lane Keller, Abraham Koshy, Mithileshwar Jha, Pearson Education Inc.

Human Resource Management: Text and Cases, K.Aswathapa Tata McGraw Hill, New Delhi,

Chunawalla & Patel Production and Operations Management, Himalaya Publishing House

**Production Technology-II Lab**  
MT-312

L     T     P  
-     -     3

Sessional : 50 Marks  
Practical : 50 Marks  
Total : 100 Marks  
Duration of Exam : 3 Hrs

**NOTE:**

1. At least ten experiments/ jobs are to be performed/ prepared by students in the semester.
2. At least 8 experiments/ jobs should be performed/ prepared from the below list, remaining 2 may either be performed/ prepared from the above list or designed & set by the concerned institution as per the scope of the syllabus of Production Technology 2 and facilities available in the institute.
3. For Learning outcomes refer to Production Technology 2 (MT-310).

**List of Experiments:**

Introduction to milling machines its types functions applications etc.

1. Practice of slab milling on milling machine.
2. Practice of slotting on milling machine.
3. To cut gear teeth on milling machine using dividing head.
4. Introduction to gear hobber, demonstration of gear hobbing and practice.
5. Introduction to various grinding wheels and demonstration on the surface grinder.
6. Introduction to tool and cutter grinder and dynamometer.
7. Study the constructional detail and working of CNC lathes Trainer.
8. To carry out welding using TIG/MIG welding set.
9. Introduction, demonstration & practice on profile projector & gauges.
10. To make a component on lathe machine using copy turning attachment.
11. To cut external threads on a lathe.
12. To cut multi slots on a shaper machine.
13. To perform drilling and Boring operation on a Component.

**Suggested reading:**

1. Manufacturing science: Ghosh and Malik, E.W. Press
2. Principles of metal cutting: Sen and Bhattacharya, New Central Book.
3. Metal cutting principles: Shaw, MIT Press Cambridge
4. Manufacturing analysis: Cook, Adisson-Wesley
5. Modern machining processes: Pandey and Shan, Tata McGraw Hill Publications

## MT - 314

### Digital And Embedded Softw. (RT sys) 2 Lab

L     T     P  
-     -     2

Sessional: 25 Marks  
Practical : 25 Marks  
Total: 50 Marks  
Duration of Exam: 3 Hrs

#### NOTE:

1. At least ten experiments/ jobs are to be performed/ prepared by students in the semester.
2. At least 8 experiments/ jobs should be performed/ prepared from the below list, remaining 2 may either be performed/ prepared from the above list or designed & set by the concerned institution as per the scope of the syllabus of Digital And Embedded Software -2 and facilities available in the institute.
3. For Learning outcomes refer to Digital And Embedded Software -2 (MT-304).

1. Introduction to microcontroller and interfacing modules.
2. To interface the seven segment display with microcontroller 8051.
3. To create a series of moving lights using 8051 on LEDs.
4. To interface the stepper motor with microcontroller.
5. To display the digital output of ADC on 16\*2 LCD Module.
6. To display character 'A' on 8\*8 LED Matrix.
7. To display the data and time on LCD Module.
8. To switch on and off relay by using keys.
9. To interface the DC motor using H-Bridge.
10. To interface a keypad with microcontroller.

This laboratory involves the practical implementation of real life challenges using 8051/68hc11. Here problem is described along with necessary flow chart and block diagram. Students are required to integrate software and hardware and provide a suitable solution. Most important the technique used by one student cannot be used by others. So by this way multiple solutions of the same problem can be achieved.

#### REFERENCE BOOKS

1. The 8051 Microcontroller: Mackenzie
2. 8051 Microcontroller: Internals, Instructions, Programming & Interfacing: Ghoshal Subrata



## MT - 316

### Applications of Control lab

<b>L</b>	<b>T</b>	<b>P</b>
-	-	2

**Sessional: 50 Marks**  
**Practical: 50 Marks**  
**Total: 100 Marks**  
**Duration of Exam: 3 Hrs**

#### NOTE:

1. At least ten experiments/ jobs are to be performed/ prepared by students in the semester.
2. At least 8 experiments/ jobs should be performed/ prepared from the below list, remaining 2 may either be performed/ prepared from the above list or designed & set by the concerned institution as per the scope of the syllabus of Applications of Control and facilities available in the institute.
3. For Learning outcomes refer to Applications of Control (MT-302).

### LIST OF EXPERIMENTS

#### MATLAB based experiments

1. For the second order systems below, find  $\xi_n$ ,  $T_s$ ,  $T_p$ ,  $T_r$ , % overshoot, and plot the step response using MATLAB.

$$T(s) = \frac{130}{s^2 + 15s + 130}$$

2. A plant to be controlled is described by a transfer function

$$T(s) = \frac{s + 5}{s^2 + 7s + 25}$$

Obtain the root locus plot using MATLAB.

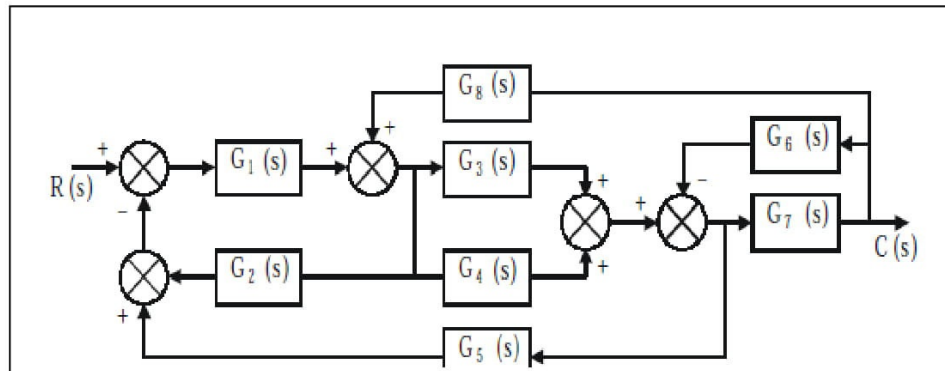
3. Write a program in MATLAB to obtain the Nyquist plots for the following transfer function for  $k = 30$ .

$$G(s) = \frac{k(s + 1)(s + 3 + 7i)(s + 3 - 7i)}{(s + 1)(s + 3)(s + 3 + 7i)(s + 3 - 7i)}$$

4. A PID controller is given by
- $$G_c(s) = 29.125 \frac{(s + 0.57)^2}{s}$$

Draw a Bode diagram of the controller using MATLAB.

5. Reduce the system shown below to a single transfer function,  $T(s) = C(s)/R(s)$  using MATLAB.



The transfer functions are given as

$$G_1(s) = \frac{1}{s + 7}$$

$$G_2(s) = \frac{1}{s^2 + 3s + 5}$$

$$G_3(s) = \frac{1}{s + 8}$$

$$G_4(s) = \frac{1}{s}$$

$$G_5(s) = \frac{7}{s + 3}$$

$$G_6(s) = \frac{1}{s^2 + 7s + 5}$$

$$G_7(s) = \frac{5}{s + 5}$$

$$G_8(s) = \frac{1}{s + 9}$$

## Hardware based experiments

### 1. DC SPEED CONTROL SYSTEM

- (a) To study D.C. speed control system on open loop and close loop.
- (b) To study of Transient performance, another time signal is added at the input of control Circuit.
- (c) To study how eddy current braking is being disturbance rejected by close and open loop.

### 2. DC MOTOR POSITION CONTROL

- (a) To study of potentiometer displacement constant on D.C. motor position control.
- (b) To study of D. C. position control through continuous command.
- (c) To study of D.C. position control through step command.
- (d) To study of D.C. position control through Dynamic response.

### 3. SYNCHRO TRANSMITTER / RECEIVER

- (a) To study of Synchro Transmitter in term of Position v/s Phase and voltage magnitude with respect to Rotor Voltage Magnitude/Phase.
- (b) To study of remote position indication system using synchro transmitter/receiver.

### 4. PID CONTROLLER

- (a) To observe open loop performance of building block and calibration of PID Controls.
- (b) To study P, PI and PID controller with type 0 system with delay.
- (c) To study P, PI and PID controller with type 1 system.

### 5. LEAD LAG COMPENSATOR

- (a) To study the open loop response on compensator.
- (b) Close loop transient response.

#### REFERENCE BOOKS:

1. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.
2. Control Systems Engg. by NISE 3rd Edition – John Wiley

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